Interrupts in ATmega2560

e-Yantra Team
Embedded Real-Time Systems Lab
Indian Institute of Technology-Bombay

IIT Bombay
February 26, 2020

Agenda for Discussion

1. Interrupt
   - What is an Interrupt
2. Interrupt-Handling in ATmega2560
   - Sources of Interrupt
   - SREG-Register
   - ISR

What is an Interrupt

What is an Interrupt

- Any signal that causes break in continuity of some ongoing process

What is an Interrupt

- Any signal that causes break in continuity of some ongoing process
- In microcontrollers interrupt signal halts the execution of main program and dedicates processor to another task

Main program exceution

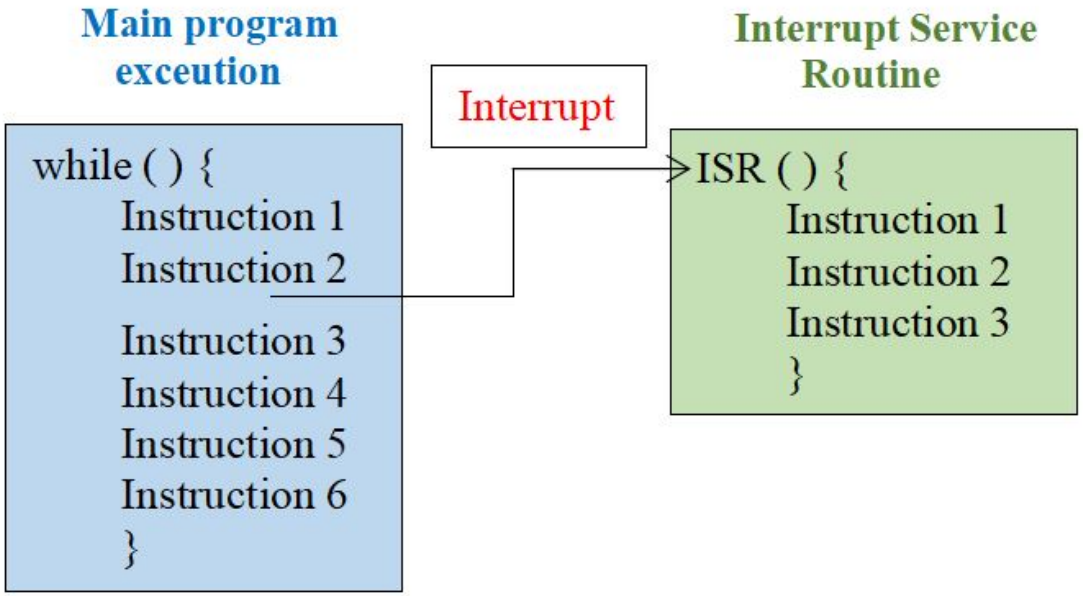
```
while ( ) {
        Instruction 1
        Instruction 2
        Instruction 3
        Instruction 4
        Instruction 5
        Instruction 6
        }
```

What is an Interrupt

- While main program is running, if an interrupt occurs, execution of main program is stopped, and program counter goes to address of ISR

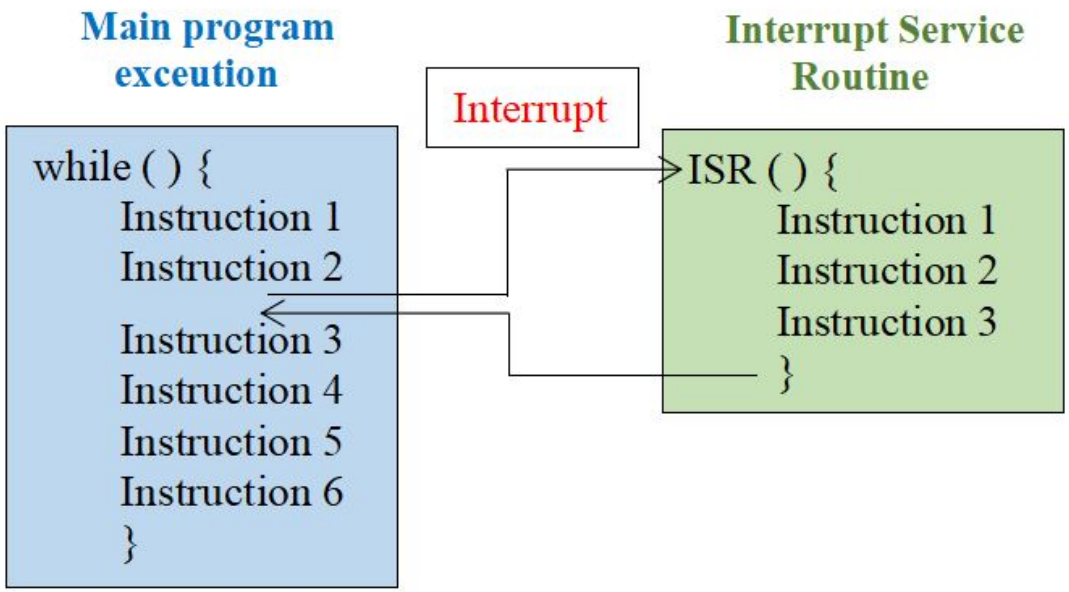
What is an Interrupt

- While main program is running, if an interrupt occurs, execution of main program is stopped, and program counter goes to address of ISR
- Interrupt Service Routine: Program that needs to be executed when interrupt occurs



What is an Interrupt

- After program inside ISR is executed completely, program counter returns back to point where main program was interrupted



Sources of Interrupt in ATmega2560

Sources of Interrupt in ATmega2560

ATmega 2560 has **Fifty-Seven** different sources for Interrupt generation

Sources of Interrupt in ATmega2560

ATmega 2560 has **Fifty-Seven** different sources for Interrupt generation

1. RESET Interrupt - [1]

Sources of Interrupt in ATmega2560

ATmega 2560 has **Fifty-Seven** different sources for Interrupt generation

1. RESET Interrupt - [1]
2. External hardware Interrupt - [8]

Sources of Interrupt in ATmega2560

ATmega 2560 has **Fifty-Seven** different sources for Interrupt generation

1. RESET Interrupt - [1]
2. External hardware Interrupt - [8]
3. Pin Change Interrupt Request - [3]

Sources of Interrupt in ATmega2560

ATmega 2560 has **Fifty-Seven** different sources for Interrupt generation

1. RESET Interrupt - [1]
2. External hardware Interrupt - [8]
3. Pin Change Interrupt Request - [3]
4. Timer/Counter Interrupts

Sources of Interrupt in ATmega2560

ATmega 2560 has **Fifty-Seven** different sources for Interrupt generation

1. RESET Interrupt - [1]
2. External hardware Interrupt - [8]
3. Pin Change Interrupt Request - [3]
4. Timer/Counter Interrupts
   - Timer/Counter0 - [3]
   - Timer/Counter1 - [5]
   - Timer/Counter2 - [3]
   - Timer/Counter3 - [5]
   - Timer/Counter4 - [5]
   - Timer/Counter5 - [5]

Sources of Interrupt in ATmega2560

ATmega 2560 has **Fifty-Seven** different sources for Interrupt generation

1. RESET Interrupt - [1]
2. External hardware Interrupt - [8]
3. Pin Change Interrupt Request - [3]
4. Timer/Counter Interrupts
   - Timer/Counter0 - [3]
   - Timer/Counter1 - [5]
   - Timer/Counter2 - [3]
   - Timer/Counter3 - [5]
   - Timer/Counter4 - [5]
   - Timer/Counter5 - [5]
5. Serial Interrupts

Sources of Interrupt in ATmega2560

ATmega 2560 has **Fifty-Seven** different sources for Interrupt generation

1. RESET Interrupt - [1]
2. External hardware Interrupt - [8]
3. Pin Change Interrupt Request - [3]
4. Timer/Counter Interrupts
   - Timer/Counter0 - [3]
   - Timer/Counter1 - [5]
   - Timer/Counter2 - [3]
   - Timer/Counter3 - [5]
   - Timer/Counter4 - [5]
   - Timer/Counter5 - [5]
5. Serial Interrupts
   - USART0 - [3]
   - USART1 - [3]
   - USART2 - [3]
   - USART3 - [3]

Sources of Interrupt in ATmega2560

ATmega 2560 has **Fifty-Seven** different sources for Interrupt generation

1. RESET Interrupt - [1]
2. External hardware Interrupt - [8]
3. Pin Change Interrupt Request - [3]
4. Timer/Counter Interrupts
   - Timer/Counter0 - [3]
   - Timer/Counter1 - [5]
   - Timer/Counter2 - [3]
   - Timer/Counter3 - [5]
   - Timer/Counter4 - [5]
   - Timer/Counter5 - [5]
5. Serial Interrupts
   - USART0 - [3]
   - USART1 - [3]
   - USART2 - [3]
   - USART3 - [3]
6. Others [7] such as Analog Comparator, ADC Conversion Complete and so on.

SREG- AVR Status Register

This register is used to Globally Enable all Interrupt

SREG- AVR Status Register

This register is used to Globally Enable all Interrupt

Bit	Symbol	Description	Bit Value
7	I	Global Interrupt Enable bit	1
6	T	Bit Copy Storage bit	0
5	H	Half Carry Flag	0
4	S	Sign Bit	0
3	V	Two's Complement Overflow Flag	0
2	N	Negative Flag	0
1	Z	Zero Flag	0
0	C	Carry Flag	0

SREG- AVR Status Register

This register is used to Globally Enable all Interrupt

Bit	Symbol	Description	Bit Value
7	I	Global Interrupt Enable bit	1
6	T	Bit Copy Storage bit	0
5	H	Half Carry Flag	0
4	S	Sign Bit	0
3	V	Two's Complement Overflow Flag	0
2	N	Negative Flag	0
1	Z	Zero Flag	0
0	C	Carry Flag	0

Note:

- **cli()** is used to clear global interrupt

SREG- AVR Status Register

This register is used to Globally Enable all Interrupt

Bit	Symbol	Description	Bit Value
7	I	Global Interrupt Enable bit	1
6	T	Bit Copy Storage bit	0
5	H	Half Carry Flag	0
4	S	Sign Bit	0
3	V	Two's Complement Overflow Flag	0
2	N	Negative Flag	0
1	Z	Zero Flag	0
0	C	Carry Flag	0

Note:

- **cli()** is used to clear global interrupt
- **sei()** is used to set global interrupt

SREG- AVR Status Register

This register is used to Globally Enable all Interrupt

Bit	Symbol	Description	Bit Value
7	I	Global Interrupt Enable bit	1
6	T	Bit Copy Storage bit	0
5	H	Half Carry Flag	0
4	S	Sign Bit	0
3	V	Two's Complement Overflow Flag	0
2	N	Negative Flag	0
1	Z	Zero Flag	0
0	C	Carry Flag	0

Note:

- **cli()** is used to clear global interrupt
- **sei()** is used to set global interrupt

`(defined in <avr/interrupt.h> header file)`

ISR-Interrupt Service Routine

ISR-Interrupt Service Routine

The format of ISR is

ISR-Interrupt Service Routine

The format of ISR is

ISR Format

```
ISR(<interupt_name>_vect)
{
    code
}
```

Example: ISR-Interrupt Service Routine

The format of ISR (ADC Conversion complete interrupt source) is

Example: ISR-Interrupt Service Routine

The format of ISR (ADC Conversion complete interrupt source) is

ISR Format

```
ISR(ADC_vect)
{
    code
}
```

Example: ISR-Interrupt Service Routine

The format of ISR (Timer/Counter0 Overflow interrupt source) is

Example: ISR-Interrupt Service Routine

The format of ISR (Timer/Counter0 Overflow interrupt source) is

ISR Format

```
ISR(TIMER0_OVF_vect)
{
    code
}
```

Thank You!